SAN FRANCISCO BAY
NUTRIENT MANAGEMENT STRATEGY

FY2024 Annual Report & Overview of FY2024-2025 Work Activities

October 2024

SFEI
SAN FRANCISCO ESTUARY INSTITUTE

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1. INTRODUCTION

This report presents an overview of the San Francisco Bay Nutrient Management Strategy (NMS) FY2025 Program Plan along with other active NMS-funded projects. After a brief summary of the program plan development process, *Section 2* provides an overview of FY2025 revenue and approved projects, and then outlines major work activities and project status. *Section 3* presents a table of NMS-related work products for FY2024 and FY2025 (thus far), along with weblinks to available products. Lastly *Section 4* summarizes active NMS-related projects supported by other funding sources.

2. FY2025 PROGRAM PLAN

2.1 Process for Developing NMS Program Plans

The NMS annual calendar (July-June) is organized to allow multiple opportunities for upcoming science priorities to be discussed and reviewed by the NMS Steering Committee (SC). In general, priorities for the following fiscal year are discussed at the NMS SC's fall meeting, and then explored again in more detail at its winter meeting. The proposed Program Plan is then reviewed, discussed, and voted on at the NMS-SC's May meeting.

The specific projects pursued in this year's annual Program Plan are based on science priorities and related work activities mapped out in the NMS Science Plan (v2), a multi-year workplan (FY2020-FY2024) developed through a series of priority-setting discussions with the NMS Steering Committee during 2018-2019. The goal of that planning process was to identify a multi-year set of projects that target the highest priority management questions, science needs, and updated goals for the second NMS Permit. Background is summarized here (program structure, management questions, program areas and science focus areas).

2.2 FY2025 Revenue

FY2025 revenue came from several sources and totaled $2,762,823 (Table 1). Funding from the Bay Area Clean Water Agencies (BACWA) via the Bay-wide Nutrient Permit was $2,200,000 (R.1). The San Francisco Bay Regional Monitoring Program (RMP) contributed Special Study funding (R.2 $250,000) to support the moored sensor network, along with contributing to ship-based monitoring (R.3 $283,000). Lastly, funds that were remaining under a FY2024 mooring project (Central Bay expansion) were reallocated, and included in Table 1 as revenue source (R.4 $29,823) to help close address a funding gap within FY25 moored sensor core monitoring (C2).

Table 1 FY2025 Revenue

	Revenue Source	Revenue
R.1	BACWA Nutrient Permit, FY2025 Funds	$2,200,000
R.2	RMP CY2024 special study funds	$250,000
R.3	RMP Contribution to ship-based monitoring	$283,000
R.4	Carry-forward funds	$29,823
	FY2025 Total Revenue	**$2,762,823**

2.3 FY2025 Work Activities

The FY2025 Program Plan's approved projects and budgets are summarized in Table 2a. For additional information, please see descriptions in the approved FY2025 Program Plan (link) .

NMS work during FY2025 can be divided into four broad categories:

1) FY2025 Core Program (C1-C4) The Core Program includes two major monitoring activities (ship-based monitoring and the NMS moored sensor network), numerical modeling, and science program management coordination.

2) New NMS Projects launched in FY2025 (Table 2a P1-P7)

3) Continuing Projects (Table 2b): projects funded during prior years (FY2024, FY2023, FY2022) that have work continuing into this fiscal year.

4) Work conducted through three nutrient-related projects that are supported by federal grants (NOAA, EPA), and summarized in Table 2c and Appendix A1-A2. The projects' goals and science questions are well-aligned with NMS priorities, and work will be pursued in close coordination with NMS-funded projects.

New FY2025 work supported by the Bay-wide nutrient permit has overall been progressing on-schedule during Q1. SFB channel cruises (C1) moved ahead as planned during FY25-Q1. Water quality data collection through the SFEI/NMS mooring network (C2) has also been moving along consistent with plans. With the mooring program's expansion over the last four years -- adding biogeochemical sensors to an existing USGS Alcatraz station (in collaboration with USGS); three South Bay shoal moorings (installed 2020); new deployment in eastern Central Bay (Emeryville Marina) -- the NMS mooring network now extends from Lower South Bay to Central Bay, measuring water quality in regions that have often gone under-monitored. Additional DO sensors at deeper depths at the San Mateo and Dumbarton Bridges offer complementary water quality data for comparison with data from SFEI's near-surface sensors at those sites. Telemetry was added at a subset of NMS sites during FY24 to allow real -time monitoring of condition. Nitrate sensors were also added to the Alviso Slough mooring site in Fall 2024, and to SFEI's SHL and DUmbarton sites. For more information, see the mooring program quarterly reports (Table 3). In addition, five high-speed mapping surveys were carried out with USGS collaborators between March and September 2023 (FY25 P1).

A subset of the new FY25 Projects have some work well-underway (P7 relaunch mussel sampling; P1 shoal mapping; P3 long-term forcings). Although the P3 budget remains untouched, considerable progress was made during FY25 Q1 through early work developing key datasets (i.e., processing of daily remote-sensed turbidity data; see Table 3 #19 & #21), of which the analysis and data-processing effort was absorbed by another NMS project that needed the same data. The other FY25 Projects are off to slower but not problematic starts.

A number of the continuing projects in Table 2b had either been paused or slowed due to work re-prioritization and capacity gaps after the August 2022 HAB event. Several of those projects moved key work ahead during late FY24 and end of FY25 Q1, (including with the help of increased capacity through recent hires), and have anticipated wrap-up dates in Fall 2024 or

Winter/Spring 2025. See Notes in Table 2b for additional information, along with the discussion in Section 2.4.2 .

Over the last 2 years SFEI staff and regional collaborators have been investing in testing, validating and applying remote-sensed data to estimate parameters like chlorophyll and turbidity (or suspended sediments) in SFB. That work yielded an improved chlorophyll algorithm, calibrated to conditions in SFB, the write-up of which was published as a journal article in March 2024 (Table 3 #7). SFEI staff also developed a set of automated scripts to download and process remote-sensed data and apply the algorithm to generate daily chl estimates for SFB. In May 2024, SFEI staff rolled out a webtool for storing, browsing, and RS-estimated chl-a and turbidity. This work will be continuing through the NOAA HAB grant.

As part of developing synthesis reports, SFEI has been building a set of web-tools for visualizing SFB water quality related data, either to accompany PDF-version of reports (for readers to explore data further) or as standalone, easy-to-update ways to track and present condition (see Table 3 10-15).

Table 2a FY2025 Core Program and Projects

	FY	Projects/Tasks		Budget	Spent thru 10/1/2024*	Encumb.**	Balance 10/1/2024*	% Spent + Encumb.	Notes
	FY25 Projects								
1	FY25	C1 Ship-based Sampling	Total	$517,000	$0	$491,600	$25,400	95%	Biweekly/monthly water quality monitoring at deep channel, throughout the entire Bay (Lower South Bay to the Sacramento River). Work has been proceeding smoothly through 9/30/2024. However there was recent news about potential hull damage to research vessel, still gathering information.
			Labor	*$25,400*	*$0*	*$0*	*$25,400*		
			Direct/Sub	*$491,600*	*$0*	*$491,600*	*$0*		
2	FY25	C2 Moored Sensor Network	Total	$600,823	$157,535	$196,902	$246,386	59%	Major program expansions between Sep 2020 and Sep 2024 (5 new sites). Funds from multiple projects (NOAA, EPA) have been supporting the most recent expansions costs (instrumetns, hardware, installation, etc.), but not necessarily supporting maintenance, data management, etc. Although field work is on generally schedule, the true cost of maintaining the larger network exceeded funds that were available (initial cost estimate in May 2024 was $550k, carry-forward funds used bring funding up to $600k), and capacity is becoming strained (e.g., keeping QA/QC apace with rate of new data arrival). The team is pursuing measures to mitigate the effects (e.g., piloting powerful data-management/QA software, which should payoff after climbing the learning curve). Over the coming months it would be valuable to discuss/strategize with the NMS-SC...priorities, covering costs vs. tapering network.
			Labor	*$337,000*	*$124,429*	*$0*	*$212,571*		
			Direct/Sub	*$263,823*	*$33,106*	*$196,902*	*$33,815*		
3	FY25	C3 Core Modeling	Total	$500,000	$100,068	$245,000	$154,932	69%	FY2024 Core Modeling work focused primarily on permit-related modeling (Table 3 #22). The FY2025 workplan C3 workplan prioritizes the recommendations made by the Model Advisory Group (MAG; MAG report-out, 2023), in particular high-priority model refinements/improvements and priority Management Applications. Specific work includes: a) refinements to phytoplankton growth and sediment diagenesis (e.g., affecting O2 budgets and denitrification); b) investments in assessing model performance (appropriate metrics, visuals); c) write up and publish model validation and mass balance interpretations (nitrogen, phytoplankton) as manuscript(s) in peer-reviewed journal(s); d) rigorously evaluate model performance by simulating additional WYs, in particular those having relevant high-frequency water quality data (wy2021-2024, wy2019, wy2020) and/or major production events (wy2003, wy2006). d) Work Plan Task 3.5 (Factors causing long-term changes in phytoplankton biomass and GPP; Simulate relevant management scenarios, e.g., load reduction scenarios.
			Labor	*$224,000*	*$79,068*	*$0*	*$144,932*		
			Direct/Sub	*$276,000*	*$21,000*	*$245,000*	*$10,000*		
4	FY25	C4 Science Program Management	Total	$700,000	$192,563	$7,600	$499,837	29%	Investments made during Q1 to augment program and project management capacity, including through hiring a full-time project manager. Strategic planning conversations are underway with the NMS-PS about further augmenting program management including through recruiting a program manager. Although the FY25 C4 budget could cover the costs of an additional full-time person this year, that is in part b/c of lower annual cost from a person starting ~mid-year.
			Labor	*$687,400*	*$191,491*	*$0*	*$495,909*		
			Direct/Sub	*$12,600*	*$1,072*	*$7,600*	*$3,928*		
5	FY25	P1 Shoal Mapping	Total	$100,000	$2,147	$86,753	$11,100	89%	This project supports continued shoal water quality monitoring by conducting high-resolution biogeochemical mapping surveys with USGS collaborators in South Bay and Central Bays through six mapping surveys in 2024 (e.g., chl, nitrate, turbidity, temperature, salinity) along with discrete samples (e.g., nutrients, phytoplankton community including HABs). This funding covered 3 of 6 surveys (and project management), while funds from the NOAA grant covered the remaining three. Five of the six surveys have been carried out (through Sep 30 2024), with the final survey scheduled for mid-October. Work progressing on schedule. Data are being analyzed through FY23 P7, with continued investigation alongside 4 others years through FY25 P2.
			Labor	*$11,100*	*$0*	*$0*	*$11,100*		
			Direct/Sub	*$88,900*	*$2,147*	*$86,753*	*$0*		
6	FY25	P2 Synthesis: Nutrient-Phytoplankton Linkages	Total	$120,000	$0	$20,000	$100,000	17%	P2 will characterize the space-time variability in mapping field data collected during wy2021, 2022, 2023, and 2024 (FY25 P1) (6 surveys per year) to investigate/quantify processes regulating dissolved inorganic nitrogen (DIN) concentrations, phytoplankton biomass, primary production rates, and dissolved oxygen levels in South and Central Bays. Intensive field sampling was carried out in this region during all four years, including six shoal mapping surveys per year and five water quality moorings. Although the P2 budget is currently untouched, work has been underway on the first-phase of processing and analysis , funded by FY23 P7, which will be wrapping up within ~1 week (technical report; see Table 3 #29).
			Labor	*$100,000*	*$0*	*$0*	*$100,000*		
			Direct/Sub	*$20,000*	*$0*	*$20,000*	*$0*		
7	FY25	P3 Synthesis: Long-term Forcings	Total	$120,000	$0	$20,000	$100,000	17%	This project will investigate environmental forcings that are known (or hypothesized) to influence phytoplankton production and/or community in SFB, and in particular on characterizing the long-term variability of those forcings over time. Potential forcings include: temperature (air, water), wind (speed, direction), suspended sediment concentrations, basin-scale forcings (e.g., el Nino, PDO), upwelling indices, solar insolation (or cloud/fog-cover). Early work will target a subset of high-priority forcings, with suspended sediment concentrations ranking near the top. Although the P3 budget remains untouched, considerable progress was made through early installments developing key datasets (i.e., processing of daily remote-sensed turbidity data; see Table 3 #19 & #21), with that work supported by other projects. Current Goal: first invest in building a 20+ year record of remote-sensed turbidity or suspended sediment concentration data; Since this may require spanning 2-3 generations of satellites/sensors, the calibration/validation has the potential to be a major undertaking. Daily (when clear-sky) has been fetched/downloaded, pre-processed (atmospheric correction, cloud detection / removal), and then turbidity estimated using well-established algorithms (although local calibration/validation is still needed) for summer/fall 2016-2024 (Jun-Sep), with next steps including filling in the rest of years. That work has been supported by other projects that also rely on estimating remote-sensed turbidiy (NOAA, EPA).
			Labor	*$100,000*	*$0*	*$0*	*$100,000*		
			Direct/Sub	*$20,000*	*$0*	*$20,000*	*$0*		

Table 2a FY2025 Core Program and Projects, cont'd

	FY	Projects/Tasks		Budget	Spent thru 10/1/2024*	Encumb.**	Balance 10/1/2024*	% Spent + Encumb.	Notes
8	FY25	P4 Synthesis: Light (Kd) and Shoal Production	Total	$70,000	$0	$55,000	$15,000	79%	This work will harmonize water quality monitoring methods between long-term deep channel monitoring and mapping surveys for phytoplankton biomass (chl-a) and community composition and calibrate/validate light attenuation coefficient measurements in shoal regions of SFB.
			Labor	*$15,000*	*$0*	*$0*	*$15,000*		
			Direct/Sub	*$55,000*	*$0*	*$55,000*	*$0*		
9	FY25	P5 Science Planning	Total	$10,000	$0	$0	$10,000	0%	Working with subsets of the NMS SC, SFEI staff will develop a draft set of science priorities aligned with management questions/decisions identified by regulators and stakeholders AND identify decisions or trade-offs, a draft multi-year plan, and a proposed approach for engaging the NMS-SC to evaluate priorities/trade-offs and revise the science plan. This work has been spinning up starting in late-August.
			Labor	*$10,000*	*$0*	*$0*	*$10,000*		
			Direct/Sub	*$0*	*$0*	*$0*	*$0*		
10	FY25	P6 Assessment Framework: Deep subtidal	Total	$10,000	$0	$0	$10,000	0%	This work involves working with WB staff and a subset of the NMS-SC to pursue identify AF priority work while focusing on immediate-term work AND begin the FY 2025 work with any remaining funds. This work will be spinning up starting in fall 2024.
			Labor	$10,000	$0	$0	$10,000		
			Direct/Sub	$0	$0	$0	$0		
11	FY25	P7 Relaunch Mussel Sampling during Summer 2024	Total	$15,000	$5,688	$0	$9,312	38%	Restart mussel sampling. Mussels were sampled/analyzed from 2015-2022, but stopped in July 2022 due to limited funding. This project is prioritizing mussel sample collection, in particular during Summer/Fall 2024: harvested biweekly, ~4-5 locations around the perimeter of Central Bay and South Bay. Samples are only being collected and archived, with sample analysis supported by future project. Mussels were collected every ~2 weeks starting in July 2024 and thus far through early October.
			Labor	*$15,000*	*$5,688*	*$0*	*$9,312*		
			Direct/Sub	*$0*	*$0*	*$0*	*$0*		
		subtotal		**$2,762,823**	**$458,001**	**$1,122,855**	**$1,181,967**	**57%**	

* Spending to Date Oct 2024: Total spending (labor, direct, subcontracts) through September 30, 2024.

**Encumbered: Funds that are included in subcontracts but not yet spent or invoiced

***Balance Oct 2025: Budget - (Spending to Date Oct 2024 + Encumbered)

Table 2b Continuing Projects (pre-FY25)

	FY	Projects/Tasks		Budget	Spent thru 10/1/2024*	Encumb.**	Balance 10/1/2024*	% Spent + Encumb.	Notes
	Prior Year, continuing projects								
12	FY24	P2 LSB DO Assessment Framework	Total	$163,187	$61,014	$14,320	$87,853	46%	Substantial progress on this project during FY24 (see Table 3 #25 VPA, #5 characterizing LSB slough DO & condition, #6 Lewis 2023 fish communities). Remaining funding will be used for i) reconvening expert group; ii) workging with expert group on developing/assembling an overarching LSB DO AF report (assembling reports pursuing investigating different lines of evidence, evaluate, strengths/limitations); iii) writing up the metabolic-index focused analysis of conditions, fish aboundance/community (an important remaining line of evidence). Work paused in summer. A reasonable goal (including to inform science planning) would be to be positioned to re-convene the expert group early in 2025, and wrap up major findings/recommendations within the first quarter of 2025, to inform science prioritization/planning.
			Labor	$128,187	$45,334	$0	$82,853		
			Direct/Sub	$35,000	$15,680	$14,320	$5,000		
13	FY24	P3 MAG Continuation	Total	$40,000	$0	$35,000	$5,000	88%	This project will support continued MAG engagement, including 1-2 meetings, and support for the MAG chair (planning, stakeholder engagement). The specific focus(es) of MAG work will be determined over the next several months, in coordination with WB and stakeholders. Convening the MAG was put on hold during FY24, when FY24 modeling work needed to redirected toward permit-focused work. During early science planning discussions, there was considerable interest in engaging the MAG to gather input/review on the viability of potential modeling approaches to inform decisions related to Permit#4. (March 2025?)
			Labor	$0	$0	$0	$0		
			Direct/Sub	$40,000	$0	$35,000	$5,000		
14	FY23	P7 Investigating space-time variability of South/Central Bay water quality using four years of high-resolution biogeochemical mapping data	Total	$67,500	$58,104	$0	$9,396	86%	This project is analyzing/interpreting water quality data collected in South/Central Bays during high-speed mapping surveys in 2021, 2022, 2023 (6 surveys/yr) and with moored sensors. Mapping data from 2024 (5 surveys) have also been incorporated into the analysis. Goals include characterizing spatial variability in key parameters to inform monitoring program design, and improved understanding of the factors causing that variability and/or regulating production, O2 budgets, and N transformations. This work is supported by combined funds from FY23 (50k) and FY24 (17.5k) funds. A draft technical report will be available in October 2024. The next round of work will be carried out under FY25 P2.
			Labor	$67,500	$58,104	$0	$9,396		
			Direct/Sub	$0	$0	$0	$0		
15	FY24	P4 Develop and apply techniques for inferring reaction/transformation rates using open-Bay moorings	Total	$57,500	$6,039	$0	$51,461	11%	The NMS moorings measure a range of water quality parameters every 15 min (O2, chl, turbidity, T, S; NO3 at some locations), and provide valuable data re: ecosystem condition. The data can also be used to estimate transformation rates, e.g., gross primary production, respiration, net ecosystem metabolism, etc. These funds are supporting method testing/refinement for env'l rate estimates, and analysis/interpretation. Considerable progress has already been made on the method development/exploration, through HAB-2022 funded projects, with goal of using most of this project's funding for applications/interpretations and write-up. A realistic goal would be to move this work forward substantially by February/March 2025 (e.g., analyses 85% done, story drafted; not written), and draft report by April/May 2025. Moving faster may be possible, but would need some reprioritization or more capacity.
			Labor	$57,500	$6,039	$0	$51,461		
			Direct/Sub	$0	$0	$0	$0		
16	FY23	P2 Assessment Framework Deep Subtidal	Total	$174,123	$93,894	$63,480	$16,749	90%	This project is building on and updating prior AF work (from 2015-2016). The second phase of the project started in FY2023, but was put on hold due to August 2022 HAB event. One key focus is an in-depth series of analyses exploring relationships between chl and HAB relative abundance using the updated eDNA/molecular data 2015-2022, and revisiting potential indicators or thresholds for assessing condition. A draft technical report will be shared late October. When originally scoped (May 2022), the second component & product were intended to focus on updating other facets of the 2016 AF work. Upcoming discussions will be help inform the best direction at this juncture.
			Labor	$85,553	$73,247	$0	$12,306		
			Direct/Sub	$88,570	$20,647	$63,480	$4,443		
17	FY23	P6 High-level Synthesis, Multi-year Report	Total	$115,651	$12,912	$24,750	$77,989	33%	Work on the high-level, graphics-rich synthesis (state of the science) was underway during Jan-Apr 2024 (Jun 2024 report goal), but was paused due to uncertainties about science priorities during Permit#3. Work restarted in August 2024, with the goal of 2 products i) lay-person overview of the NMS program (goals, focus areas, progress), draft report Nov 2024; ii) more in-depth (but still high-level) state of the science report (graphics-rich, accessible), late-Jan/Feb 2025). [This project combines FY23 P6 and P5, to support completing both reports].
			Labor	$83,596	$5,607	$0	$77,989		
			Direct/Sub	$32,055	$7,305	$24,750	$0		
18	FY23	P11 Trend Synthesis	Total	$106,279	$69,904	$12,000	$24,375	77%	Continuation of long-term data analysis project, assessing long-term trends in SFB water quality parameters. Work was paused due to Aug 2022 HAB event (and related field work, analysis, etc.). Products thus far include the WQ-trend webtool, Beck et al (2022), and de Valpine et al 2023. Work picked up again in spring/summer 2024; one technical report will be available in late-Oct 2024, with a second report shared in Jan/Feb 2025.
			Labor	$84,484	$60,109	$0	$24,375		
			Direct/Sub	$21,795	$9,795	$12,000	$0		
19	FY22	P1B Tech Synthesis: factors influencing high- biomass/low-DO in Lower South Bay	Total	$100,000	$64,515	$15,291	$20,194	80%	This project is investigating the tidally-driven exchanges of nutrients, biomass, and dissolved oxygen between restored ponds, sloughs, and Lower South Bay using high-frequency mooring data, targeted sampling, and numerical models. In order to quantify these fluxes and transformation rates in this tidally-dynamic (and strong water quality gradients) region of SFB, we are pursuing a mass balance approach that pairs results from numerical model simulations (hydrodynamics, tracers) with observational data to quantify nitrogen influx to and biomass efflux from ponds, sloughh -->Bay fluxes, and losses / transformations. A set of major improvements to the LSB hydrodynamic model wrapped up in Mar-Apr 2024 (see Table 3 #1), with tracer simulations and analysis / interpretation moving forward during summer 2024. A technical report is planned for roughly November 2024.
			Labor	$57,161	$36,967	$0	$20,194		
			Direct/Sub	$42,839	$27,548	$15,291	$0		

Table 2b Continuing Projects (pre-FY25), cont'd

	FY	Projects/Tasks		Budget	Spent thru 10/1/2024*	Encumb.**	Balance 10/1/2024*	% Spent + Encumb.	Notes
20	FY22	P14 HAB Synthesis	Total	$75,000	$38,604	$23,546	$12,850	83%	Includes funds from FY21 & FY22. This project is focused on developing an overall synthesis of HAB-related data in SFB (HAB organisms, toxins biota). An expert advisor group was convened for two meetings, and an interim draft technical report written (SFEI 2023). Work was temporarily paused during FY24 while some issues with DNA-based HAB data were resolved. (Method troubleshooting is being carried out by project FY22 P7). Substantial progress was made during summer 2024 on addressing some of the major challenges, with an additional 4-6 weeks (calendar days) needed to wrap-up bioinformatics work, reprocess, reanalyze, etc. Current goal: reprocessed data and graphics, and updated storyline, mid-Dec 2024; reconvene expert group, mid-/late-Jan (share full draft); incorporate suggestions/edits, distribute updated draft to NMS-SC mid-Feb 2025).
			Labor	$30,766	$17,916	$0	$12,850		
			Direct/Sub	$44,234	$20,688	$23,546	$0		
21	FY22	P7 Phytoplankton-HAB Monitoring	Total	$105,000	$75,009	$28,775	$1,216	99%	Includes funds from FY21 & FY22. This proejct has been carrying out method development, HAB measurements, including DNA-sequencing techniques, w/ particular focus on method refinements or improvements. Two technical reports completed (SFEI 2020, 2021), along with data analysis in the draft HAB synthesis (above). Next steps include: updating datasets and documentation, after bioinformatics work complete (see FY22 P14); publish database, classifier, dataset; remaining funds will be used to support additional sample processing or analyses. Going forward, the new NOAA grant will take on the bulk of HAB method.
			Labor	$39,726	$38,510	$0	$1,216		
			Direct/Sub	$65,274	$36,499	$28,775	$0		
22	FY22	P19 Coastal Nutrient Fluxes	Total	$325,000	$137,992	$177,008	$10,000	97%	Combines FY21&FY22 funds. This project, a multi-group collaboration (UCSC, UCLA, SCWWRP, SFEI), is investigating the effects of SFB nutrients along the coast. The project experienced a pause due to postdoc turnover early during covid, but work has resumed. The project has two work products so far (Zhou et al. 2023; Cooper et al. 2024, see Table 3), and biogeochemical model products anticipated in ~1 years.
			Labor	$10,000	$0	$0	$10,000		
			Direct/Sub	$315,000	$137,992	$177,008	$0		
23	FY 23/24	3300 031 Supplemental Environmental Projects: HAB Funding	Total	$252,300	$232,299	$5,000	$15,001	94%	These funds were secured to support HAB monitoring, assessment, and synthesis work in the wake of the 2022 Heterosigma bloom in SF Bay. Remaining funds are being reserved for completing the technical report write-up and manuscript submission. Current goal: draft report, mid-Nov 2025 along with submitted manuscript.
			Labor	$224,290	$209,289	$0	$15,001		
			Direct/Sub	$28,010	$23,010	$5,000	$0		
		subtotal		**$1,581,540**	**$850,286**	**$399,170**	**$332,084**	**79%**	

* Spending to Date Oct 2024: Total spending (labor, direct, subcontracts) through September 30, 2024.

**Encumbered: Funds that are included in subcontracts but not yet spent or invoiced

***Balance Oct 2024: Budget - (Spending to Date Oct 2024 + Encumbered)

During FY2025, work will also move forward on the three nutrient-related projects, summarized in Table 2c and Appendix A1-A2, that are supported by federal grants (NOAA, EPA). The projects goals and science questions are well-aligned with NMS priorities, and work will be pursued in close coordination with NMS-funded projects.

Table 2c Overview of additional SFB nutrient projects that are on-going.

Overall Goal(s)	Tasks/focus areas	Project Period & Funding	Funder, Team
NOAA-MERHAB: Develop & implement a robust HAB monitoring program for the San Francisco Estuary (Bay, Delta) *For more details, see Appendix A1 at the end of this document.	- develop/apply remote sensing algorithms (chl, HAB metrics) - molecular-techniques for detecting/quantifying HAB-taxa - augment in-situ continuous monitoring - HAB data-dashboard (informing managers, regulators, stakeholders)	Oct 2023-Sep 2027 Total: $2.99mill FY25: ~$600,000	NOAA-MERHAB *Team*: SFEI, USGS, DWR UCSC, Baykeeper, Water Board
"*Destination Clean Bay*" Models/Decision-support-tool development for nutrient management *For more details, see Appendix A2 at the end of this document.	- develop/apply numerical modeling approaches for nutrient source apportionment and evaluating management alternatives - sediment transport modeling - simulating future (environmental) scenarios, effective management options	Dec 2023-Nov 2027 Total: $1.8mill (nutrient-related funding) FY25: ~$425,000	EPA-WQIF *Team*: SFEI, USGS, UCSC, RMA
"*BayInsight*" Identify high-priority monitoring needs; augment or refine monitoring activities to address needs	- stakeholder engagement; building collaborations with programs with monitoring mandates; - data analysis/interpretation, identify high-priority/high-leverage needs (parameters/indicators, regions, techniques); - identify 'optimal' monitoring program design; implement: augment/refine program components	Jun 2024-May 2028 Total: $2.99mill FY25: ~$400,000	EPA-WQIF *Team*: SFEI, USGS, DWR

4. WORK PRODUCTS

NMS-related work products from FY2024 and FY2025 (to date) are compiled in Table 3, along with associated links.

Table 3 Work Products: FY2024 and FY2025 (through 9/30/2024)

1	*Report*: Development and Refinement of the Lower South Bay Numerical Model (2024)	Link
2	*Report*: Continuous Suspended Sediment Monitoring in South and Lower South San Francisco Bay: Year Two Report (2024)	Link
3	*Report*: Eutrophication Resistance and Microbial Nitrogen Removal in South San Francisco Bay (2024)	Link
4	*Report*: Interannual Ecosystem Metabolism of an Estuarine Delta Measured Using a High Frequency Sensor Array (Draft Oct 2024)	Link
5	*Report*: Dissolved Oxygen Conditions in Lower South Bay Sloughs (Draft Feb 2024)	Link
6	*Report*: Lewis, LS. 2023. Fish communities and dissolved oxygen in wetlands of the San Francisco 22 Estuary. Final report submitted to the SFEI, CA. (Jan 2024)	Link
7	*Report* (and journal article): Kudela et al 2024 Evaluation and Refinement of Chlorophyll-a Algorithms for High-Biomass Blooms in San Francisco Bay (USA) (2024)	Link
8	*Reports*: a) NMS mooring network, FY2024 Quarterly Update #1 b) NMS mooring network, FY2024 Quarterly Update #2	Link *#1* Link *#2*
9	*Report*: Gross et al 2024 Estimating Biogeochemical Rates Using a Computationally Efficient Lagrangian Approach (journal article). Method development, and application of tracer techniques, relevant for NMS applications. (prop1 funded, PI: R Holleman, RMA; partial NMS support for D Senn)	Link
10	*Webtool*: Water quality trends: Updated to include longer data records (back to 1980s, when available) and to include dissolved inorganic nitrogen (e.g., DIN).	Link
11	*Webtool*: Lower South Bay Dissolved Oxygen: exploring DO condition	Link
12	*Webtool*: POTW Loads over time: data explorer	Link
13	*Webtool*: HAB Molecular Data: data explorer	Link
14	*Webtool*: Imaging Flow Cytobot (IFCB) viewer: view time series of Imaging Flow CytoBot data	Link
15	*Webtool*: San Francisco Bay Water Quality Data Viewer: USGS cruises 1980-present; time-series and channel cross-section data	Link

16	*Dataset*: Chl, DO, and other data from Alcatraz mooring (chl, DO start August 2023), in collaboration with USGS	Link
17	*Dataset*: DO sensors installed at near-bottom and mid-depth, San Mateo Bridge and Dumbarton Bridge; data available via telemetry.	DMB SMB
18	*Technical Memo and Dataset*: Developing space-time varying semi-empirical estimates for light attenuation ($K_D(x,y,t)$) for use within biogeochemical simulations. Documentation of approach, incremental refinements, and light attenuation coefficient (K_D) dataset .	Link
19	*Webtool*: Remote sensed data webtool for San Francisco Bay. Sentinel-3 chlorophyll and turbidity : daily automated fetch/process/plot. *links to the right are for Jul-Aug 2023 imagery*	chl link turb link
20	*Dataset*: Processed remote-sensed chlorophyll-a: 2021-2024 March-September (and on-going, 2024); analyzing/processing prior years 2016, 2017, 2018, 2019, 2020 (Jun-Sep currently available; work underway for other months). Data will be used for model calibration/validation, data analysis/synthesis, and will be processed/updated daily	Link (e.g., 2024)
21	*Dataset* : Processed remote-sensed turbidity: 2021-2024 March-September (and on-going, 2024); analyzing/processing prior years 2016, 2017, 2018, 2019, 2020 (Jun-Sep currently available; work underway for other months). Data will be used for model calibration/validation, data analysis/synthesis, and will processed/updated daily	Link (e.g., 2024)
22	*Report*: Simulations of Load Reduction Scenarios to Inform Nutrient Management Planning for San Francisco Bay (March 2024)	Link
23	*Technical Memo*: Summer 2024: Condition / potential-HAB tracking	Link
24	*Report:* NOAA-MERHAB 1-year Project Update	Link
25	*Report*: Virginian Province Approach to Dissolved Oxygen in Lower South San Francisco Bay Sloughs (Updated draft Fall 2023)	Link
26	*Report*: Nonparametric and additive mixed meta-analysis (de Valpine et al. *in review*)	Link
28	*Report*: Characterizing chl in the Gulf of the Farallones using multi-decadal time series of chl, wind stress, surface currents, sea surface temperature, and the SFB plume. (Cooper et al., manuscript in prep. *Dataset:* Compiled dataset for use in evaluating coastal biogeochemical model performance	Link
29	*Report*: Production explains spatial variations of nutrient availability and pH across the South SF Bay shoals (draft)	Link
30	*Report*: Relating phytoplankton molecular percent abundances to chlorophyll-a and mussel toxin concentration in San Francisco Bay (Deep-subtidal assessment framework)	*available late Oct 2024*
29	*Report*: NMS Moored Sensor Program Semi Annual Report (Jan-Oct 2024)	*available late Oct 2024*

Appendix A1: Overview NOAA-MERHAB Project

- The overarching goal of the San Francisco Estuary (SFE) MERHAB project (SFE-MERHAB) is to establish the technical foundation, program design, and strategic plan for implementing a robust Estuary-wide HAB monitoring program.
- Project Objectives
    - Enhance monitoring data resources: rapid detection of HAB events, improved understanding of HAB drivers and ecology
        - New technologies and tools: Remote Sensing, Molecular Tools, Expanded in-situ continuous monitoring
        - Community Science
    - Integrate Data Streams & Decision Support Tools
        - Gather and integrate diverse datasets (existing, new, system-wide)
        - SFEstuary HAB Dashboard
    - Fill data and knowledge gaps about HAB and toxin production and transport, to inform monitoring strategies across ecological and management boundaries.
    - Develop a coordinated HAB monitoring and management strategy across the Estuary to improve HAB event response and manage HAB impacts.
- For more details:
    - NOAA-MERHAB 1-year Project Update (Table 3 #24)
    - project webpage

Appendix A2: Overview: EPA WQIF Project, Destination Clean Bay

- Joint project with the RMP, totaling $3mill, approximately ~$1.5mill of which is directly targets NMS science priorities, with a particular focus on developing modeling tools/approaches and applying those tools/approaches to investigate management options.
- The funded modeling work includes several nutrient-focused technical areas that are important for upcoming work (total for the following nutrient modeling work, $600,000)
    - development of modeling approaches and/or post-processing approaches for tracking point source zones of influence and quantifying relative nutrient contributions (source apportionment);
    - identifying meaningful/useful future scenarios, and simulating those future scenarios (environmental-change scenarios) to characterize impacts, and to the extent possible investigate frequency or probability of occurrence and risk;
    - simulating and analyzing management scenarios (e.g., load reductions);
    - support for community modeling: support for model documentation, making model publicly available (versions/code, data, documentation) as a research or management tool for the science/management community.
- Early NMS modeling work identified light attenuation coefficient data (Kd = f(SSC)) as an important data gap. This portion of the project will support the development and calibration/validation of a sediment transport model for SSC, driven by the NMS hydrodynamic model. Sediment transport modeling work is being pursued in

collaboration with the RMP's PCB modeling effort. Most of the early sediment transport work has focused on regions/approaches that are primarily relevant to PCB modeling. NMS-focused sediment transport work will ramp up during FY25. (total NMS-relevant budget: ~$600k)

- support shoal mapping work. These funds will be used to support ~4 mapping surveys (and related sample analysis/data QA) (~$100k)
- Support the processing and analysis/calibration-validation of remote-sensed products for primarily sediment/Kd, and potentially some work on chla. Sediment/Kd RS-data products will be used for calibrating/validating sediment transport models, and will also be used for updating/improving the interim semi-empirical Kd data being used, with the RS data providing valuable insights into sediment/Kd levels along the shoals. RS-chl-a products will be used for water quality model calibration, and may also contribute to early-warning system development. (Total funding $200k)